DRAFT

OPERATIONAL REQUIREMENTS DOCUMENT

FOR THE

UNMANNED AERIAL VEHICLE (UAV) TACTICAL CONTROL SYSTEM (TCS)

VERSION 3.0

1. General Description of Operational Capability

a. Mission Area. The requirement relates to the Office for the Under Secretary of Defense (Acquisition and Technology) Mission Areas 212 (Indirect Fire Support), 217 (Land Warfare Surveillance and Reconnaissance), 223 (Close Air Support and Interdiction), 227 (Air Warfare Surveillance and Reconnaissance), 232 (Amphibious, Strike, and Antisurface Warfare), 237 (Naval Warfare Surveillance and Reconnaissance), 322 (Tactical Intelligence and Related Activities (TIARA) for Tactical Land Warfare), 345 (Tactical Communications), 370 (Electronic Combat) and 373 (Tactical Surveillance, Reconnaissance, and Target Acquisition).

b. System Description. The Tactical Control System (TCS) is the software, software-related hardware and the extra ground support hardware (antennae, cabling, etc.) necessary for the control of the Tactical Unmanned Aerial Vehicle (TUAV), and Medium Altitude Endurance (MAE) UAV, and future tactical UAVs. The TCS will also provide connectivity to identified Command, Control, Communications, Computers, and Intelligence (C4I) systems. TCS will have the objective capability of receiving High Altitude Endurance (HAE) UAV payload information. Although developed as a total package, the TCS will have the capability to be configured and down-scaled to meet the user's deployability or operator limitations.

(1) Software. The major focus of the TCS program is software. The software will provide the UAV operator the necessary tools for computer related communications, mission tasking, mission planning, mission execution, data processing, and data dissemination. The software will provide a high resolution, computer generated, graphics user interface that enables a UAV operator that is trained on one system to control

different types of UAVs or UAV payloads with minimal additional training. The TCS will be in an open architecture and be capable of being hosted on computers that are typically supported by the using Service. The software developed will be Defense Information Infrastructure/Common Operating Environment (DII-COE) compliant, non-proprietary, and the architectural standard for all future tactical UAVs.

(2) Hardware. For the U.S. Army and the U.S. Marine Corps, the TCS will be an integral part of the TUAV two HMMWV-based Ground Control Stations (GCSs). The Army will obtain TCSs in addition to those required for the TUAV program to receive/control Predator UAV information. For the U.S. Navy, the TCS will initially support the TUAV and receive MAE payload data aboard L-Class Ships. The TCS will be the control system for future ship-based UAVs and UAV operations. Since ships already provide the necessary infrastructure to support a computer based system (electrical power, environmental control, radio networks, etc.), the TCS is virtually the GCS for the Navy. For the U.S. Air Force, the TCS will be an upgrade of the existing GCSs for the MAE UAV. The hardware of the TCS must be capable of being scaled or being modular to meet the varying needs of the Services. The TCS hardware will allow for long range communications from one TCS to another, data storage expansion, access to other computers to share in processing capability, and multiple external peripherals.

c. Operational Concept. The TCS will provide the common software architecture between MAE UAV, TUAV and future tactical UAVs[1]. Accordingly, the operational concept for the TCS will be the same as the operational concept for the UAV system it supports.

(1) Levels of Interaction. TCS will support five levels of UAV interaction.

(a) Level One is the receipt and transmission of secondary imagery and/or data.

(b) Level Two is the direct receipt of imagery and/or data.

[1] Excludes legacy UAV systems

(c) Level Three is the control of the UAV payload in addition to direct receipt of imagery/data.

(d) Level Four is control of the UAV, less launch and recovery, plus all the functions of level three.

(e) Level Five is the capability to have full function and control of the UAV from takeoff to landing.

(2) Joint Operations Concept. The TCS will allow interoperability between the Services and their UAV systems with varying levels of UAV interaction. For example, a shipboard UAV detachment launches a TUAV from an LHA-Class ship (Level 5) to observe the beachhead. Marines and Sailors on board the LHA receive the UAV video via a TCS fed closed circuit television (Level 1). Marines and Sailors on other ships have direct receipt of imagery via remote video terminals (Level 2). The Air Force at a Forward Operating Location (FOL) hundreds of miles away launches an MAE UAV (Level 5) to determine the necessary engineering requirements of a future Army Corps operation. To ensure their needs are met, the Army Corps has a direct, real-time influence on the payload (Level 3). During this supporting operation, the MAE is also carrying communications and data relays to activate tactical remote sensors in various locations. The TCS controls these sensor relays and feeds them to the respective C4I system (Levels 3 and 1, respectively). A few days later, the Navy/Marine team passes airborne control of an LHA-launched TUAV to a detachment ashore. At the end of the mission the TUAV is passed back to the embarked TUAV detachment (Level 4).

(3) Scaled and Modular Design. The TCS should be capable of being hosted on a variety of computers. The initial core of software will be generically written to provide Level Five interaction for both TUAV and MAE UAVs and establish the architecture for future tactical UAVs. Since not all recipients of UAV information require all levels of TCS capabilities, the software, and software related hardware, if required, will be developed so that it is scaleable to meet users' needs. The TCS will prevent users from entering levels of interaction for which they are not authorized by software and or hardware configuration.

d. Support Concept. Each Service will support the TCS as part of the UAV system which is organic to them.

e. Mission Need Statement (MNS). The Chairman of the Joint Requirements Oversight Council (JROC) signed the MNS for a Close Range Reconnaissance, Surveillance, and Target Acquisition (RSTA) Capability[2] and a MNS for a Long Endurance Reconnaissance, Surveillance, and Target Acquisition Capability on 5 January 1990.[3] Both MNSs state the need to interface with selected standard Department of Defense Command, Control, and Intelligence Systems, Architectures and protocols, both current and planned. There are no non-materiel alternative solutions that will establish a standard software architecture for UAVs. JROC Memorandum 135-95, 31 October 1995, stated the need for "the development of a common ground reception, processing and control system to ensure full interoperability with other UAVs and collection systems." JROC Memorandum 010-96, 12 February 1996, stated, "To fully exploit Predator's capability at all levels, it is imperative that the system become fully compatible and interoperable with the UAV Tactical Control System..."

2. Threat

a. Validated Studies. The latest Defense Intelligence Agency validated System Threat Assessment Report (STAR) for the Joint Tactical UAV (UAV-SR/UAV-CR) Sep 95 is the baseline for threat support. UAV threat data can also be found in Office of Naval Intelligence-Threat Assessment #028-93, Medium Range Unmanned Aerial Vehicle (UAV-MR), Sep 93. Information concerning the threat and Information Warfare (IW) can be found in National Air Intelligence Center Report, NAIC-1571-731-95, Electronic Combat Threat Environment Description, Apr 1995.

b. Threat to be Encountered. Although the TCS may not be subject to the following threats, mission planning and execution software should account for the following considerations. The TCS will control UAVs that are in close proximity to heavily defended areas and will be used to counter the general threat to the unit it supports. The UAV will be subject to hostile air defenses that may include the full range of antiaircraft systems including conventional small arms, automatic antiaircraft weapons, and crew-served systems using radar, optics, and electro-optics for tracking and engagement. The threat also will include shoulder-fired Surface-to-Air Missiles (SAMs), launcher-

[2] The Close Range UAV mission need will be met through the TUAV ORD
[3] Joint Requirements Oversight Council Memorandum 003-90

mounted SAMs, air-to-air weapons launched by both fixed-wing aircraft and helicopters, anti-radiation missiles, and directed energy weapons.

c. Information Warfare. IW is defined as the actions taken to achieve information superiority by affecting adversary information, information-based processes, information systems, and computer-based networks while defending one's own information, information-based processes, information systems, and computer-based networks. IW includes, but is not limited to electronic warfare, physical destruction, operational security, deception, and information attack. As the mission of UAVs is to provide information, the system may be a lucrative target of IW. Communications/data links may be subjected to enemy EW threats, physical anti-radiation weaponry, and physical destruction.

3. Shortcomings of Existing Systems

a. Current. The Predator and Outrider UAV systems were initially procured under the Advanced Concept Technology Demonstrators (ACTDs) acquisition program approach. Their software and UAV data links do not have compatibility and are not interoperable. The ground control stations have neither the required capabilities nor the architectural growth to satisfy all of the operational requirements of the joint Services. Additionally, each time a software or hardware configuration is developed to be compatible with new or improved warfighting systems, a new software contract must be negotiated for each type of UAV control station.

b. Projected. There is no standard architecture for future tactical UAV systems.

4. Capabilities Required

a. System Performance

(1) General. The TCS will enable the UAV operator to communicate, receive mission tasking, conduct mission planning, execute the mission, collect, process, and disseminate data for the TUAV and MAE UAV (threshold) and support data collection from HAE UAV (objective)(key performance parameter). The TCS shall:

(a) Provide an open software architecture that can support future tactical UAVs (threshold).

(b) Have software based on the Defense Information Infrastructure/Common Operating Environment per Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (ASD(C3I)) Joint Technical Architecture (JTA)(threshold).

(c) Have ergonomically designed operator controls and displays. The controls will allow air vehicle and payload operators to perform real time mission control, mission monitoring, and mission updates/modifications while wearing cold weather clothing or in a Mission Oriented Protective Posture (threshold).

(d) Have monitor(s) that provide easy reading of displays (threshold).

(e) Be menu driven and have displays in a X-windows motif (threshold).

(f) Have peripheral ports to drive external devices (threshold).

(g) Be capable of supporting additional software modules for controlling future payloads, payload capabilities (e.g., autosearch and automatic target tracking), and future tactical UAVs (threshold).

(h) Allow operators to have simultaneous flight and payload control of at least two air vehicles, beyond line of sight, using one TCS (threshold)(key performance parameter).

(i) Be capable of being interoperable with different types of UAVs and UAV payloads across the 5 levels of UAV interaction (threshold), multiple platforms/payloads simultaneously (objective) (key performance parameter).

(j) Be capable of meeting the operational and physical security requirements of the systems with which it is interoperable (threshold).

(2) Mission Planning. For mission planning the TCS will:

(a) Be capable of importing National Imagery and Mapping Agency (NIMA) Digital Terrain Elevation Data (DTED),

Digital Feature Analysis Data (DFAD), Arc Digitized Raster Graphic (ADRG) and scanned hard copy maps (threshold). The system will be capable of importing map information via UAV operator procedure (threshold) and should be capable of incorporating vector format and Compressed ADRG (CADRG) maps (objective).

(b) Include basic flight planning tools. As a minimum these tools will include:

1 Weight and balance take off data calculations.

2 Fuel calculations.

3 Terrain avoidance warning and minimum reception altitude calculations for line of sight flights.

4 Payload search area information such as: visual acuity range due to atmospheric conditions; diurnal transition periods for thermal imagery, and lunar and solar terrain shadowing (objective).

(c) Be capable of providing point-and-click route and sensor planning (threshold).

(d) Program AVs with mission planning data prior to launch (threshold).

(e) Have tools for importing or creating overlays for fire support coordination measures, airspace control measures, and threat (objective).

(f) Survivability planning:

1 Provide override of payload and UAV automated/ preprogrammed inputs (threshold).

2 Provide a method of displaying UAV signature versus threat, before and during flight (objective).

3 The system should be capable of displaying overlays or icons of known threat systems and displaying the threat engagement envelopes and associated radar terrain masking for those threats for route planning (objective).

(g) Be capable of storing mission plans and exporting them to other TCSs (threshold) and exporting them to force level mission planning systems (objective).

(h) Be interoperable with Service-specific mission planning systems (objective).

(i) Be capable of changing the mission plan while the air vehicle is airborne (threshold).

(3) Launch and Recovery. These functions support air vehicle launch and recovery operations. The system will be ergonomically designed and provide sufficient cues to allow the pilot to safely take off, land and navigate under Instrument Flight Rules (threshold). The TCS will support an automatic launch and recovery system (objective).

(4) Mission Execution. During mission execution, the TCS will:

(a) Display the location and systems status of the UAV (threshold).

(b) Display the search footprint of the payload on the moving map (threshold).

(c) Provide dynamic mission and sensor retasking during operational mission execution (threshold).

(d) Receive, process, format, store and retrieve flight and payload data and perform limited exploitation of payload data (threshold).

(e) Have the capability to receive and control payloads on a UAV that is being controlled from another TCS (threshold).

(f) Provide the capability to pass control of a UAV from one TCS to another (threshold).

(g) Provide the operator a caution/warning when the UAV system has identified a malfunction (threshold).

(h) Enable antenna switching when the UAV is masked by obstructions (threshold).

(5) Imagery Intelligence Processing. The TCS shall provide limited exploitation capabilities, to include voice and textual reporting for spot/mission objectives. TCS imagery processing work station capabilities shall include, but not be limited to:

(a) Video/SAR frame grabbing, image annotation, image archiving, and video/SAR recording/playback, and data dissemination (threshold).

(b) The standards developed for compliance with Common Imagery Ground/Surface Station (CIGSS), United States Imagery Standards (USIS), and GCCS (threshold).

(c) The capability to display Near-Real Time (NRT) imagery with annotation to include date/time group, target location when in the center field of view, north seeking arrow, AV position and heading (threshold).

(d) Built-in word processing and text capability including the ability to overlay textual information on imagery (threshold).

(e) Ports for outputting data and imagery to a hard-copy printer and recording media (threshold).

(f) A means of inputting data from external data storage systems (threshold).

(g) The capability to distribute NRT video to selected users (including commercially available television monitors and VCRs) via external ports (threshold).

(h) Image enhancement (threshold).

(i) The capability to select/deselect cross hairs (or other similar ICON) to identify center of target (threshold).

(j) The capability to display target symbols (threshold) in variable sizes (objective).

(k) The capability to interoperate with a server to receive, extract and push intelligence data (threshold).

(6) Communications Subsystems

(a) Data Links

1 The TCS must support a simultaneous uplink and downlink capability (threshold).

2 The TCS will provide interfaces with the respective UAV program-provided data links for command and control and UAV data (threshold). To ensure interoperability with other imagery data links, the LOS links will comply with CDL standards (objective).

3 Data links will support a simultaneous LOS and beyond LOS capability (threshold).

(b) Other Communications. The TCS will be interoperable with the C4I systems listed in paragraph 5f(2) of this ORD per ASD(C3I) JTA standards (threshold)(key performance parameter)[4]. The TCS will provide the following communications support[5]:

1 The capability to connect to a local area network (threshold).

2 The capability to use cable to deliver live video imagery in multiple locations (threshold).

3 The ability to use Service specific ground or airborne UHF, VHF, and UHF/VHF, and HF radios for digital message transmission while using the same radios for record traffic (threshold).

b. Logistics and Readiness

(1) Operational Availability. The TCS must meet the mission capability criteria established by the MAE UAV and TUAV ORDs. For each TUAV system, the TCS will provide full, independent computer redundancy.

[4] Not all C4I systems listed are required at IOC. Joint Service priority will be promulgated via Joint Requirements Oversight Council Memorandum

[5] Refer to the TUAV and MAE UAV ORDs for communication requirements that are not connected to the TCS.

(2) Maintenance. Expected Maintenance Levels. The TCS will be maintained in accordance with the UAV ORD for that Service and the level of repair analysis for the hardware chosen.

(3) Surge and Mobilization Objectives and Capabilities. The TCS must meet the deployment criteria for the organic unit to which it is assigned.

c. Other System Characteristics

(1) Electrical Power. The TCS must use standard military worldwide 110/220 volt 50/60 hertz generators and commercial power sources. Use of standard electrical power sources available within the Department of Defense (DoD) family of ground mobile, airborne, and shipboard electrical power sources is required. The system must be capable of restoring power in sufficient time to avoid loss of critical mission data or loss of UAV control during power outages. The TCS will have an uninterrupted power supply for critical phases of mission execution (threshold).

(2) Integration. The TCS will have an objective capability to be integrated and operated from tactical and command and control aircraft and submarines.

(3) System Communications/Interfaces. The system communications and interfaces are listed in paragraph 5f of this ORD. Where applicable, the interfaces for those systems are for both radio and wire connectivity.

(4) Natural Environmental Factors. The TCS must operate in world wide climatic conditions, i.e., same climatic conditions in which the TCS shelter/platform is designed to operate.

5. Program Support. The TUAV and MAE UAV ORDs are companions to the TCS ORD. Joint Potential Designator are U.S. Army (joint), U.S. Marine Corps (joint), U.S. Navy (joint), U.S. Air Force (joint). Allied interest has not been identified.

a. Maintenance Planning

(1) A TCS support and fielding package will be developed and available for operational testing.

(2) The TCS will be maintained in accordance with each Services' UAV maintenance concepts and procedures.

b. Support Equipment.

(1) Support Concept. Support for the TCS will be in accordance with the Integrated Logistical Support Plan (ILSP) and the maintenance concepts and policies of the individual Services. Standard tools, TMDE, repair parts, and lubricants will be used. Exceptions will be considered on a case-by-case basis. To the maximum extent possible, general purpose test equipment (GPTE) and common tools resident in each Service will be used to perform all corrective and preventative maintenance at all authorized levels of maintenance. Tools and test equipment required but not resident in each Service inventory will be identified as special tools and special purpose test equipment (SPTE) respectively and kept at a minimum.

(2) Fault Detection/Location (FD/L). The TCS hardware and software shall include FD/L during initial system computer boot-up.

c. Human System Integration

(1) Manpower Constraints. The TCS manpower requirements shall not exceed the Services' guidelines for their respective UAV Program.

(2) Training Assessment

(a) General. Training shall be balanced between institutional, New Equipment Training (NET), and unit training. Instructor and key personnel training will be required.

(b) NET. Receiving units will receive NET as the system is fielded.

(c) Institutional Training. Training devices will be required for the institutional training base.

(d) Unit Training. Unit training will be conducted in both garrison and field environments--individual and collective modes.

(e) Sustainment Training Devices. The system will provide, for the operator and maintainer, the capability for incorporation of embedded/ add-on interactive training with self-paced instruction, duplicating UAV flight performance characteristics, capabilities, and limitations. (The TUAV TCS system will be compatible with the U.S. Army Intelligence and Electronic Warfare Tactical Proficiency Trainer (Multiple UAV Simulation Environment) as an objective.)

(f) Operator/Technical Manuals. All Operator Manuals and Technical Manuals will be verified and validated prior to initial operational test.

(3) System Safety and Health Hazard Assessment. System Safety and health hazards, if any, will be identified and evaluated. Risk levels and a program to manage the probability and severity of hazards will also be developed.

d. Computer Resources

(1) The TCS system should conform with the National Institute for Standard Technology (NIST) Federal Information Processing Standard (FIPS) Publication 151-2 (POSIX.1) (objective).

(2) The TCS will provide a 50% spare memory storage capacity over storage delivered (threshold). 75% spare memory storage over storage delivered (objective). To meet growth requirements the TCS should be capable of adding additional storage without a major hardware reconfiguration.

(3) The TCS throughput should not exceed 50% of throughput capability delivered (25% percent of throughput over capability delivered objective).

(4) The TCS shall comply with the ASD(C3I) JTA. This includes, but is not limited to, the language, the computer, database, architecture and interoperability (threshold).

e. Other Logistics Considerations. The TCS hardware must be mounted and/or ruggedized to withstand inter and intra theater movement. If containers are provided, they must be reusable and enable the operators to set equipment within the established timelines in their ORDs.

f. Command, Control, Communications, and Intelligence

(1) The TCS will support direct connectivity to standard DoD tactical (VHF, UHF, and UHF/VHF, and HF) radios, Mobile Subscriber Equipment, and military and commercial satellite communications.

(2) The TCS shall be capable of entering DII-COE compliant (C4I) systems, to include GCCS, that comply with the Technical Architecture Framework for Information Management and the Joint Technical Architecture. Interoperability should include but not be limited to: radio data burst connectivity to Automatic Target Hand-off Systems (ATHS), Advanced Field Artillery Tactical Data Systems (AFATDS), and Army Deep Operations Coordination System (ADOCS); wire connectivity to the All Source Analysis System (ASAS), the Intelligence Analysis System (IAS), the Joint Standoff Target Attack Radar System (JSTARS) Ground Station Module/Common Ground Station ((GSM/CGS); the Joint Maritime Command Information System (JMCIS); Closed Circuit Television (CCTV), Advanced Tomahawk Weapons Control Station (ATWCS), Joint Deployable Intelligence Support System (JDISS); TROJAN Special Purpose Integrated Remote Intelligence Terminal (SPIRIT) II; Joint Service Imagery Processing System (JSIPS); JSIPS-Navy and JSIPs Tactical Exploitation Group (TEG); JSIPS Tactical Exploitation System (TES); Service mission planners, the Theater Battle Management Core System (TBMCS); and the Guardrail Common Sensor/Aerial Common Sensor (ACS) Integrated Processing Facility (IPF), Modernized Imagery Exploitation System (MIES), Enhance Tactical Radar Correlator (ETRAC), Contingency Airborne Reconnaissance System (CARS); and Common Operational Modeling, Planning, and Simulation System.

g. Transportation and Basing. The TCS will be transported into the theater as an organic component of the operational UAV system being deployed. Transportation in theater for Army and Marine Corps systems will be by ground transport, air, or rail. For the Air Force transportation to the theater will be by air. When in theater, the USAF GCS must be capable of being moved around an established air field. Basing for the system will follow the plan for UAV units and service command echelon requirements as delineated in paragraph 6 below.

h. Standardization, Interoperability, and Commonality

(1) Data burst messages will comply with Variable Message Format (VMF) Technical Interface Design Plan.

(2) The TCS will adhere to DoD regulations and policy governing military standards for logistics, POL, tools, TMDE, and other support items.

i. Mapping, Charting, and Geodesy Support. The TCS will require support from NIMA for digitized map displays with elevation data.

j. Environmental Support. Environmental support will be the same as that required for the respective UAV System.

6. Force Structure

a. U.S. Army. Requires the TCS for 38 TUAV systems to meet active division, brigade, and armored cavalry regiments. The Army requires 24 TCS for elements at Division and Corps (preliminary estimate).

b. U.S. Marine Corps. Requires the TCS for 11 TUAV systems to meet pre-positioning, war reserve, and expeditionary force requirements. VMU-1 will have 4 systems; VMU-2 will have 4 systems. There will be 3 TUAV systems on maritime pre-positioned ships. The Marine Corps requires 6 TCS for JSIPS-TEG and JSTARS Common Ground Station (preliminary estimate).

c. U.S. Navy. Requires 12 LHA/LHD ships to be outfitted with TCS control and dissemination equipment and 1 land-based TCS for TUAVs (Land-based system will be configured in HMMWVs at VC-6, Naval Air Station, Patuxent River for training. Requires a total of 88 TCS (CV/CVN, LCC, LPD 17, surface combatants, and submarines) (preliminary estimate).

d. Air Force. Requires 12 TCS for the 11th Reconnaissance Squadrons at Indian Springs, Nevada (preliminary estimate).

e. Training. Additional TCSs will be required to support the Joint DoD UAV Training Center.

7. Schedule Considerations

a. Initial Operational Capability (IOC). IOC is achieved after each Service has been fielded 1 production representative

system with ILS procurement (training, spares, technical publications, support equipment) in place and testing (developmental and operational) completed. The level of performance necessary to achieve IOC requires 1 system in a final configuration with operators and maintenance personnel trained and initial spares with interim repair support in place.

(1) IOC. Third Quarter, FY 99.

(2) Impact if IOC is Not Met. If IOC is not met, UAV interoperability will be delayed and additional costs to retrofit the already-procured UAV systems will be incurred.

b. Full Operational Capability (FOC). FOC will be achieved when all maintenance and repair support, software support, test equipment and spares are in place and the systems are effectively employable.

(1) FOC. Fourth Quarter, FY 00.

(2) Impact if FOC is Not Met. Same as the IOC rationale.